MEMORANDUM

TO: Washington State Department of Ecology

FROM: Area-Wide Soil Contamination Project Contractor Team

DATE: May 8, 2002

SUBJECT: Information Survey Results

In accordance with the scope of work and schedule for contract number C0200196, this memorandum provides the Washington State Department of Ecology (Ecology) with a description of the results of the Area-Wide Soil Contamination Project information survey. This document is the final deliverable for the information survey, which is detailed in Tasks 3.3, 4.3, and 5.2 of the contract scope of work.

Over four months (January–April, 2002), the contractor team conducted over twenty phone interviews and researched over 200 documents, orientated around the three primary areas of analysis for the project:

- Improving our understanding of the sources of contamination and the nature and geographic extent of area-wide soil contamination problems (nature and extent of contamination or Task 3)
- Identifying feasible measures for protecting the health of people who live or work on or near properties that contain widespread low-to-moderate levels of soil contamination (protective measures or Task 4)
- Identifying current institutional frameworks (e.g., laws, regulations, land use planning processes, etc.) and new initiatives that will improve efforts to reduce risk to public health posed by widespread low-to-moderate level soil contamination and remediate existing threats (institutional frameworks or Task 5)

Sections below describe the purpose of the information survey and the survey documentation, summarize the findings of the information survey relative to key information needs, and describe follow-up actions. Appendices describe how the information survey was carried out (Appendix A), summarize each interview (Appendix B), and provide annotated bibliographies for each of the main three project analytic areas (Appendix C through Appendix E).

Preliminary results of the information survey were reviewed at the April 2002 Task Force meeting. Follow-up on Task Force suggestions for additional research is discussed in the section on next steps later in this memorandum.

Purpose of the Information Survey and Survey Documentation

Information gathering and learning will continue through the life of the Project. In that context, the goal of the information survey was to identify and gather a wide range of information on the status and content of past, current, and proposed area-wide soil contamination projects, public health initiatives, and cleanup activities in other states and countries that might be applied to area-wide soil contamination problems in Washington state, and to gather related source and reference materials. The information survey is a resource that the contractor team, agency staff, the Task Force and Work Groups can refer back to as they produce future, more focused, Project reports, papers, analysis and other deliverables. Because the main purpose of the information survey was to create a resource for the Project, the emphasis in documenting the information survey was on providing clear and easy access to the fullness and richness of the all information gathered.

To provide this access, information gathering was documented in three ways:

- Raw notes from telephone interviews.
- Contact summary sheets for telephone interviews.
- Annotated bibliographies for literature searches.

The contact cover summary sheets and annotated bibliographies are particularly important. Contact summary sheets provide contact information for each interviewee (name, affiliation, area of expertise), identify by analytic area and by Project deliverable the areas of the Project to which the interview is most relevant, summarize key points from the interview, list reference materials gathered and individuals who might be contacted in the future for further or additional information, and summarize follow-up that was carried out as part of the information survey. Annotated bibliographies for each analytic area provide reference information for each document reviewed and a brief summary of the document content. Contact summary sheets are attached to this memorandum as Appendix B. Annotated bibliographies are attached as Appendix C through Appendix E.

In addition, all reference materials gathered as a result of the telephone interviews, along with raw interview notes, have been provided to the contractor-team leads for the three main analytic areas. Raw interview notes have also been provided to Ecology. References reviewed as part of the literature survey are kept at Landau Associates, Inc., 7800 SW Durham Road, Suite 500, Tigard, OR 97224. These materials are available to Task Force and Work Group members on request.

Summary of Survey Results

This section reiterates the key points from each interview organized by Project analytic area and further organized by the main information needs identified in January 2002.[1]

Analytic Area 1: Nature and Extent of Contamination

The goal of the geographic/geochemical assessment (Task 3) portion of the information survey was to gather information on potential sources of contamination and methods used to characterize the nature and extent of area-wide contamination of soil by arsenic, lead, or other similar contaminants. With this overall goal in mind, the contractor team focused on three specific information needs:

1. Identification of historical resources used to determine where area-wide contamination was likely to be found.
2. Identification and characterization of sampling approaches and analytic methods used to characterize area-wide soil contamination problems in a cost-effective manner.
3. Identification of the nature and extent of arsenic and lead area-wide contamination in other states.

[1] See memorandum, *Draft Information Survey Approach for the Area-Wide Soil Contamination Project*, January 29, 2002. Note that the January 29, 2002 memorandum contemplated integration of the results of the literature review with the results of the telephone interviews. On further reflection, and based on resource and timing constraints, the literature reviews were instead organized by key topic under each of the Project analytic areas and generally were not integrated into the summary results of the telephone interviews.

Potential Sources of Area-Wide Soil Contamination: Many interviewees provided information on the concentrations and distribution of arsenic, lead, and other contaminants in soils at historical orchard sites, smelter sites, and mining sites. Key findings include the following.

- Point sources included metal smelters (often with associated mining and/or refining facilities) at the following locations: Anaconda, MT; Bunker Hill, near Kellogg, ID; Murray, UT; Denver, CO (Vasquez Boulevard/I-70 site and Globe site); Trail, BC; Oakland, CA (Verdese Carter Park site); Douglas, AZ (Phelps-Dodge smelter site); and Herculaneum, MO.
- Non-point sources of area-wide soil contamination included pesticide residues at former orchards and other agricultural sites in places such as Phoenix, AZ; Haywood County, NC (Barber Orchard site); southern New Jersey; Massachusetts; New York; and Australia.
- Anthropogenic sources of lead contamination included lead-based paint in and surrounding old buildings and leaded gasoline near roads. Residues from leaded gasoline were particularly important as a source of contamination at the Verdese Carter Park site; this source also complicated sampling efforts at the Anaconda site. Exposure to lead from indoor lead-based paint was often dealt with in conjunction with soil cleanup at sites at places such as Herculaneum, Trail, and Verdese Carter Park.

The contractor team is primarily using information on potential sources of area-wide soil contamination in the preliminary estimates task (Subtask 3.4).

Historical Resources: Very few information-survey interviewees identified historical resources that were used to determine where areas of area-wide soil contamination might be located. Historical resources identified included aerial photographs, diagrams of former smelter sites, and the census of agriculture. Key findings include the following.

- Site managers at the Murray, UT smelter site used historical aerial photographs and drawings of the former smelter to predict where elevated levels of contaminants would likely be found and design sampling plans for the site.
- The Colorado Department of Public Health and the Environment used historical aerial photographs in another way, to investigate whether elevated levels of arsenic were associated with sites that used to be agricultural areas; data did not support this association for the area around the Vasquez Boulevard/I-70 site in Denver.
- As part of New Jersey's historic pesticide contamination task force effort, the New Jersey Department of Environmental Protection referred to the census of agriculture and other sources to identify counties that were likely to have historical pesticide contamination.

The contractor team is using this information on historical resources in the preliminary estimates task (Subtask 3.4) and in the confirmation sampling pilot project (Subtasks 3.6 and 3.7).

Sampling Approaches: Cleanup programs at smelter sites researched as part of the information survey all included some form of soil sampling to characterize contamination in the area around the smelters, yet sampling approaches varied somewhat according to conditions at the sites. Key findings include the following.

- Sampling approaches varied from systematic, yard-by-yard sampling at residential properties nearest to the smelter sites (for example, in the community of Anaconda) to targeted sampling of areas with the greatest risk of exposure (For example, in Trail, sampling in residential areas focused on exposed play areas, drip lines along houses where there might be lead-based paint residues, and the top 3 cm of soil.).

- Difficulties obtaining access to properties also determined where sampling occurred near the smelter sites. To get around this problem, state and federal agencies sampled at public properties (e.g., at Verdese Carter Park), asked for volunteers from the agencies to have their own yards sampled (e.g., in the Denver area), and took samples along roadways (e.g., outside the community of Anaconda), although sampling along roadways resulted in samples with higher lead concentrations.
- Sampling along transects was often used instead of grid sampling for large areas to reduce costs (e.g., at the Phelps-Dodge smelter site in Douglas, AZ). Dr. Peter Veneman, a soil scientist with the University of Massachusetts Amherst, however, noted based on his research of Massachusetts' orchard soils, that grid sampling is necessary to obtain statistically valid results at historical orchard sites, even though it might not be cost effective for large areas.
- The State of New Jersey and, for site assessments of proposed school sites, the State of California have developed protocols for sampling on formerly agricultural soils with historical pesticide contamination. For smelter sites, the Panhandle Health District developed sampling protocols for the Bunker Hill site and the Environmental Protection Agency (EPA) is developing sampling protocols for the Anaconda site.

The contractor team is using this information on sampling approaches and, in particular, the sampling protocols developed for other locations to develop tools for identifying area-wide soil contamination problems (Subtask 3.8) and to develop sampling guidance for land developers and property owners (Subtask 3.10).

Analytic Methods: Standard laboratory analyses and tests were generally used at the smelter sites we researched to analyze soils data. At the Bunker Hill site, the Panhandle Health District determined that full contract laboratory procedures were not necessary as part of the sampling protocols; the State of New Jersey's guidelines for soil testing on current or former agricultural properties, however, do require those procedures. Key findings include the following.

- Several project managers (including Steve Hilts, Robbie Morris, and Michael Storck) recommended that portable XRF (X-Ray Fluorescence) technology be used as a screening tool over large areas to identify "hot spots," or areas with high concentrations of metals. The Utah Department of Environmental Quality and site managers in Joplin, Missouri have used XRF technology for this purpose. The California Department of Toxic Substances Control accepts XRF analysis for lead soil contamination at proposed school sites, but does not have similar guidance for other metals.
- A data kriging model is begin used at the Anaconda site to estimate arsenic levels within a 10-mile radius of the smelter; program managers at Anaconda found that the kriging model was predictive of lead and arsenic soil concentrations.
- Investigation into the potential sources of contamination at the Vasquez-Boulevard/I-70 site included speciation of arsenic and lead types near the site. A U.S. Geological Survey (USGS) group is researching the use of lead isotopes as tracers to distinguish between natural background levels of lead and anthropogenic soil contamination from lead-arsenate pesticides and other products.

The contractor team is considering this information on analytic methods as part of the identification of tools that local governments could use to identify area-wide contamination problems within their jurisdictions (Subtask 3.8) and the development of sampling guidance for developers and property owners (Subtask 3.10).

Area-Wide Contamination in Other States: We identified very few area-wide soil contamination studies in the U.S. through information-survey interviews other than the site characterizations and assessments conducted for individual smelter or orchard sites, such as those described above. Two ongoing studies of area-wide contamination that are not associated with particular point sources are worth noting:

- USGS is currently conducting a study of arsenic soil contamination in New England, which has both a history of lead arsenate pesticide use and high natural background concentrations of arsenic.
- The State of Colorado, EPA, and the City and County of Denver have formed a work group to assemble information on the nature and extent of area-wide soil contamination in the greater Denver area and investigate options to address the contamination.

As a supplement to this information survey, the contractor team will conduct follow-up research on the both of these projects, including interviews with appropriate contact people. See the discussion of supplementary interviews in the section on next steps, later in this memorandum.

Analytic Area 2: Protective Measures

The primary objective of the protective measures (Task 4) portion of the information survey was to gather information on remedies that have been considered, selected, and implemented to address widespread contamination of soil by arsenic, lead, or other similar contaminants. Information gathering for this analytic area focused on two related information needs:

1. Identification of technically feasible remedies (including individual protective measures).
2. Assessment of their cost, implementability, and effectiveness.

Key findings related to protective measures are discussed below in the context of these information needs and objectives.

Identification of Technically Feasible Remedies

Information survey interviewees identified a number of technically feasible remedies to address low-to-moderate level arsenic and lead soil contamination.[2] Remedies used at smelter, mining, and formerly agricultural sites include the following.

A. *Soil Removal and Replacement:* At almost all of the smelter sites researched (Anaconda, Bunker Hill, Globeville, Herculaneum, Murray, Vasquez-Boulevard/I-70, and Verdese Carter Park), removing contaminated soil and replacing it with clean fill was the primary means of remediating residential areas. Soil was also removed as part of emergency cleanup actions at residential properties with historical pesticide contamination in Burlington Township, NJ, and in Haywood County, NC (Barber Orchard site). The depth of soil excavated at these sites varied from 6 inches (at places such as Anaconda and Verdese Carter Park) to 18 inches (in Murray and for home gardens in Globeville).

B. *Capping:* Another common remedy used at smelter sites was covering contaminated soils with vegetative or non-vegetative caps. Soils were either capped in place (*in situ* capping) or consolidated at other locations (for example, a berm or a road bed) and then capped (*ex situ* capping). Capping was used to control exposure to lead and/or arsenic in soils at smelter sites including Anaconda, Bunker Hill, Globeville, Murray, Trail, and Verdese Carter Park, typically in commercial or industrial areas. Capping was also one of the remedial options the New Jersey

[2] This discussion only pertains to remedies identified through interviews with survey contacts; the contractor team researched and identified additional technically feasible remedies as part of the literature review for this analytic area (see Appendix C).

Historic Pesticide Contamination Task Force recommended for new development at formerly agricultural sites and it is a common approach for brownfields redevelopment projects (e.g., in Woburn, MA). Capped areas generally have land-use controls associated with them to ensure that the caps remain protective.

C. *Land-Use Controls:* Land-use controls (also sometimes known as institutional controls) are restrictions on access to or use of properties. There are two types of land-use controls—public and private. Public or governmental controls are restrictions on land use that are within the traditional police powers of state and local governments (e.g., siting restrictions, zoning, subdivision regulations, permits, and public notices/advisories). Private or proprietary controls (e.g., easements, covenants, and reversionary interests) are private contractual mechanisms contained in deeds or other documents transferring properties; these are often known as "deed restrictions." Example land-use controls from the information survey include the following.

   - The City of Murray, UT created an overlay zoning district for the Murray City Smelter Site where development permits would be required before any excavation, demolition, construction, or change in land use occurred.
   - A mix of private and public land-use controls are used and will be used at the Anaconda smelter site, including restrictive covenants, conservation easements, ground water use controls, and a development permit system.

D. *Education and Community Protection Measures:* There are a number of well-understood measures that individuals can take to minimize their exposure to arsenic and lead. These include measures such as raising garden beds, minimizing tracking of dirt and dust into homes by removing shoes out of doors, planting grass or otherwise covering bare areas, and hand washing. All of the large smelter-site cleanups and the state initiatives for addressing historical pesticide contamination (in New Jersey), for brownfields redevelopment (in Massachusetts and elsewhere), and for school construction or redevelopment (in California) researched included some form of public education or outreach. Sites that emphasized community or individual protection measures include Anaconda, Bunker Hill, Globeville, Murray, Trail, and Verdese Carter Park. For example, at the Anaconda smelter site, public and private entities are working together to develop an information package for developers to avoid potential financial impacts from perceived risks.

E. *Health Monitoring and Case-by-Case Risk Management:* Unlike other smelter-impacted areas, in Trail, BC, there has been very little soil removal in residential areas. Instead, the Trail Lead Program has emphasized education, health monitoring, individual "case management" services, emissions reductions, and barrier methods (such as dust control and maintenance of groundcover) to reduce exposure. If regular blood-lead testing of children between the ages of six months and five years in Trail reveals elevated blood-lead levels, the Kootenay Boundary Community Health Services works with families to identify exposure pathways and reduce exposures. Exposure controls include soil cover, dust suppression, HEPA (high efficiency particulate arrest) vacuum cleaner purchases, lead-paint removal, and soil replacement on a case-by-case basis. Other cleanup sites that have health monitoring programs include Globeville, Murray, and Herculaneum, although for these sites, soil replacement was the primary remedy selected for residential areas.

In addition, survey contacts identified other remedies that also may be technically feasible for addressing low-to-moderate level arsenic and lead soil contamination. Although none of the specific cleanup or land-use redevelopment projects we interviewed people about for the information survey used these remedies, several interviewees considered, suggested, and/or researched the following remedies as possible means of addressing arsenic and lead soil contamination.

F. *Soil Blending and Tilling:* Blending contaminated soil with clean soil from on or off a site to dilute surface concentrations of arsenic, lead, and similar contaminants was one of the main recommendations of the New Jersey Historic Pesticide Contamination Task Force. Because of the Task Force's recommendations, the New Jersey Department of Environmental Protection now allows soil blending to reduce contaminant concentrations at sites with historical pesticide contamination, but not other sites. Soil scientists we interviewed (Peter Veneman and Ravi Naidu) also suggested soil blending as a potential remedy for former agricultural sites, although Dr. Veneman noted that soil blending might not be as effective for arsenic soil contamination as for lead soil contamination, because arsenic is more mobile than lead. Managers in Trail and Anaconda considered mixing or deep tilling of soil to bury contaminants, but did not select this remedy. EPA found that tilling was not a feasible remedy for residential areas at the Anaconda site.

G. *Phytoremediation:* Phytoremediation consists of using plants to remove contaminants from soils, sediments, or ground water. Dr. Lena Ma of the University of Florida has done research on the brake fern, a plant that can take up several thousand parts per million of arsenic in soil; however, her research is not at the application stage. The Trail Lead Program considered phytoremediation as a remedy, but found that it was not practical for residential areas.

H. *Treatment:* Chemical treatment of contaminated soil involves adding chemicals to reduce the mobility and/or toxicity of the contaminants. The Australian research institute CSIRO is researching the use of a mixture of chemicals to immobilize arsenic, depending on the soil type and level of contamination. The Trail Lead Program did both lab and field tests of *in situ* soil amendment using phosphate to reduce the mobility of lead and iron to reduce the mobility of arsenic. Lab trials, but not field trials, of this treatment remedy were successful in Trail. Managers at the Bunker Hill site found that treatment was not a realistic option.

I. *Soil Washing:* The Australian research institute CSIRO has tested soil washing in the lab, but not in the field.

The contractor team is considering the remedies identified through the information survey in the technical memorandum on site categories and remedial actions (Subtask 4.4). Remedies that are selection for further analysis will be researched further as part of Subtask 4.4.

Cost of Remedies: Both the New Jersey Historic Pesticide Contamination Task Force and the Trail Community Lead Task Force evaluated per unit costs of various remedial actions as part of the task forces' final reports. Soil removal and replacement is among the most expensive remedial options, while planting groundcover and consolidation and covering of contaminated soils on site are among the least expensive remedial options. Soil mixing or blending have intermediate costs. Costs of remediation activities and ongoing costs for educational and health programs and for implementation, monitoring, and enforcement of land-use controls at sites we researched include the following.

- According to interviewees, it would cost billions of dollars to replace soil at developed properties with historical pesticide contamination in New Jersey; cleanup costs could be more than the value of homes. (Partly for this reason, the New Jersey task force focused on undeveloped rather than developed properties with pesticide residues.)
- The cleanup at Bunker Hill will cost $40 million; the multi-faceted institutional control program overseen by the Panhandle Health District currently costs $175,000 annually.
- The 10-year task force effort in Trail cost Can$5 million for the environmental, health, and educational activities of the Trail Lead Program. Currently, the health monitoring, educational, and case-management services in Trail cost about Can$40-50,000 per year.

- The Record of Decision for the community of Anaconda estimated the costs of soil removal and replacement at 50 residential yards to be about $250,000 to $300,000 and the cost of the community protection measures program to be $75,000 per year (in 1996 dollars).
- The potentially responsible party (PRP) at the Murray smelter site paid the City of Murray $50,000 to implement the institutional controls that were associated with the Murray smelter remedy.

The contractor team will use this information on costs of individual remedies in the cost analysis issue paper (Subtask 4.4).

Implementability and Effectiveness of Remedies: Managers at the Bunker Hill and Globeville smelter/mining sites found removal and replacement of soils at residences to be an effective remedy, leaving no residual contamination in surface soils. Bunker Hill's lead intervention program, involving physician awareness, prenatal monitoring, and school programs, along with other activities have driven blood-lead levels in Smelterville from 40 to 3 micrograms/deciliter over its 20-year implementation period. In Trail, children's blood-lead levels have dropped to below 5 micrograms/deciliter following reductions in smelter emissions and implementation of exposure control programs, even as soil lead concentrations remained at 700-750 ppm. Managers in the Trail Lead Program attribute most of the reductions in child blood-lead levels in Trail to reductions in smelter emissions, rather than to broader educational campaigns and community dust abatement measures. There is evidence, however, that the one-on-one case management services in Trail have been effective in reducing children's blood lead levels for families that received counseling and exposure control assistance.

The effectiveness of land-use or institutional controls (and the caps or engineering controls they may protect) depends to some degree on how well the land-use controls are monitored and enforced. Interviewees (including Mike Bellot, Greg Jordan, and Michael Storck) noted many common problems with institutional controls in practice that limit their effectiveness, including:

- Local agencies are often responsible for implementing, monitoring, and enforcing institutional controls, but they may not be aware of these requirements or funding may not be available.
- Data on institutional controls at properties are not easily accessible to the public.
- There is little routine monitoring of institutional controls; problems come as surprises.
- Institutional controls often contain imprecise, unclear language.
- Institutional controls are often assigned to an entire parcel rather than a specific part of the parcel where contamination may be a problem.

The contractor team will use information on the implementability and effectiveness of remedies in the human health and environmental assessment issue paper, permanent solutions issue paper, and model remedy report of Subtask 4.4 and in the institutional analysis issue paper of Subtask 5.7.

Analytic Area 3: Institutional Frameworks

The primary objective of the institutional frameworks (Task 5) portion of the information survey was to gather information on the strengths and weaknesses of institutional approaches to implement solutions to area-wide soil contamination problems. Research on institutional frameworks focused on three information needs:

1. What alternatives under state and federal cleanup laws might be utilized further to address area-wide soil contamination (for example, prospective purchaser agreements for the development of formerly agricultural lands).

2. The possibilities and limitations of solutions tied to real-estate transactions (development, lending), local land-use and planning ordinances, and other mechanisms.
3. How innovative approaches to brownfields redevelopment might apply to area-wide soil contamination.

Key findings related to institutional frameworks are discussed below in the context of these information needs and objectives.

Alternatives under State and Federal Cleanup Laws

Most of the cleanup projects researched occurred under the authority of the federal *Superfund* law (including Anaconda, Bunker Hill, Murray, Vasquez-Boulevard/I-70, and Verdese Carter Park smelter sites; Barber Orchard, NC; and Woburn, MA) or, in the case of Globeville, CO, the State Superfund law. Barber Orchard was one of the first formerly agricultural sites to be included in the Superfund National Priorities List (NPL), since in general contamination that is the result of legally applied agricultural pesticides in not subject to NPL listing. Other federal legislation and policies potentially relevant to area-wide soil contamination issues include:

- EPA's *lender liability policies* (which New Jersey adopted as well), which offer banks protection from liability and thereby facilitate the investigation and cleanup of contaminated sites
- the *Small Business Liability Relief and Brownfields Revitalization Act of 2001*, which establishes a separate federal funding source for brownfields redevelopment and provides additional liability protection for small businesses

In addition to federal and state Superfund cleanups, soil contamination, once found, is often addressed through *state voluntary cleanup programs*. Cleanup efforts at formerly agricultural properties or on brownfields typically occur through state voluntary cleanup programs. State and local health and environmental agencies can facilitate cleanup by developing clear, practical guidelines for common contaminant situations and by educating residents about measures that can be taken to minimize exposures. Other than the risk assessments and similar studies conducted at Superfund sites, *systematic means for identifying contamination problems at properties appear to be uncommon.* Contamination problems tend to be identified by chance or through land-use conversion or property transfer. Examples of state cleanup approaches from the information survey include the following.

- California is the only U.S. state that has enacted legislation that requires environmental screening and cleanup of proposed school sites, as a condition for receiving public funds. The State of New York is considering similar legislation.
- The Arizona Department of Environmental Quality considered establishing best management practices for sites with contamination due to legally applied pesticides, but decided instead to treat sites with historical pesticide contamination no differently than other contaminated sites in the State's voluntary cleanup program.
- In Massachusetts, state-licensed site professionals oversee most of the voluntary cleanup projects in the state, leaving the Massachusetts Department of Environmental Protection to oversee cleanups at only the most contaminated sites.
- New Jersey's Historic Pesticide Contamination Task Force decided not to address the issue of pesticide residues on already developed properties, but instead developed recommendations for identifying and addressing historical pesticide contamination problems in new developments.
- In New Jersey, the State regulations have been revised to require deed notices (which become part of the property title) and to require biennial certifications of whether institutional and

engineering controls are being properly maintained. New Jersey also has a "cap cop" who periodically inspects engineering and institutional controls.

The contractor team is using information gathered on state and federal cleanup approaches in the development of case studies of cleanup and land-use development projects (Subtask 5.3). The case-study sites include the Bunker Hill Superfund smelter and mining site in Idaho and land-use development/redevelopment projects in New Jersey (in formerly agricultural areas) and Massachusetts (on brownfields). In addition, information on alternatives under state and federal cleanup laws will be used in the identification of institutional alternatives (Subtask 5.4) and the institutional analysis of those alternatives (Subtask 5.8).

Real-Estate Transactions, Local Land-Use and Planning Ordinances, and Other Mechanisms

Survey contacts identified a range of institutional approaches to implementing solutions to area-wide soil contamination problems, including the following.

Local government land-use and planning approaches:

- Planning and zoning to restrict future land uses at a site (e.g., to allow only non-residential uses of properties in areas with greater residual soil contamination or less protective remedies).
- Requirements for soil testing or environmental cleanup of properties before development (e.g., as done by certain municipalities in Burlington County, NJ, where most new developments are on formerly agricultural properties).
- Requiring development permits for certain activities at sites (e.g., before excavating or digging into areas with soil caps on the Bunker Hill site).
- Monitoring, maintenance, and enforcement of institutional controls at cleanup sites. (Lack of regular monitoring and enforcement is a common problem with institutional controls, complicated by the fact that local agencies may not be aware of their responsibilities or have the resources to implement them.)

Private approaches tied to real-estate transactions:

- Covenants, easements, or other private restrictions on the use of properties (e.g., the PRP at a smelter site may transfer land to a private developer with the condition that the land use on the site must be commercial or industrial).
- Requirements of lending institutions for environmental assessments of properties. (If contamination is found, banks may ask developers to remediate properties and obtain no-further-action letters from the state environmental agency to provide assurance against liability.)
- Information packages and other outreach materials for developers and/or prospective home buyers (e.g., as realtors and local development corporations are developing at the Anaconda smelter site to overcome out-of-state developers' perceptions of legal and financial risks).

Other mechanisms:

- Licensing contractors to perform site inspections and/or oversee cleanup activities (e.g., as used at Bunker Hill and in Massachusetts).
- One-call systems like utilities use to allow people to easily determine whether and what kind of institutional controls are in place at a site. (EPA is piloting this approach in Wisconsin.)
- Incentives for homeowners (e.g., at the Bunker Hill site, residents are allowed to dump one truck load of contaminated soil in the municipal landfill for free).

In addition to identifying public and private institutional approaches to implementing solutions to area-wide soil contamination or similar problems, survey contacts (including Mike Bellot and Jerry Cobb) recommended strategies for the design of institutional control programs such as the following.

- "Layer" the institutional controls at sites. It is important to use multiple institutional controls at sites, since each control has strengths and weaknesses and may help achieve a different objective.
- Enter into an agreement with local agencies to provide money to the local agencies for implementation, monitoring, and enforcement and to clarify roles and expectations.
- Carefully research the authorities for institutional controls and select the appropriate institutional controls for those authorities (e.g., an excavator wouldn't come across land-use controls associated with property titles, but would be able to use a call-in number).
- Use a comprehensive approach to risk management, including education, data collection, enforcement, and an administrative system. The Panhandle Health District calls the institutional control program it administers for the Bunker Hill site a "cradle-to-grave" approach.

The contractor team is using information gathered from the information survey on the possibilities and limitations of solutions tied to real-estate transactions, local land-use and planning ordinances, and other mechanisms in the description and analysis of up to five institutional case studies (Subtask 5.3), the identification of institutional alternatives (Subtask 5.4), and the funding and institutional analysis of the alternatives (Subtasks 5.7-8).

Brownfields Redevelopment

Brownfields are abandoned or underused properties that already have been developed and may be contaminated from past land uses. Examples include former gas stations and industrial or manufacturing areas of older cities. Brownfield sites are generally smaller than area-wide contamination areas (a large brownfields site might be 100 acres), but many of the institutional issues related to brownfields redevelopment projects are likely to be applicable to addressing area-wide soil contamination. For example, brownfields redevelopment projects often involve coordinated efforts among multiple agencies and private institutions and outreach or educational efforts to overcome developers' and lenders' perceptions of financial and legal risk from developing contaminated properties. Three aspects of state and federal brownfields initiatives seem particularly applicable to institutional approaches for addressing area-wide soil contamination problems, these are:

- *Funding sources and financing mechanisms.* State, federal, and local agencies often use a variety of tax incentives, grants, revolving loan funds, and other strategies to encourage investment in economically depressed urban areas with brownfields and fund site assessments and cleanups (e.g., the U.S. Department of Housing and Urban Development's Community Development Block Grant program).
- *Comfort and liability protections.* EPA and some states have established special liability protections and other means of providing "comfort" about liability (e.g., Massachusetts' Attorney General's covenant-not-to-sue program) for brownfields redevelopment projects.
- *Transferring financial risk through insurance.* The State of Massachusetts established a state-subsidized environmental insurance program specifically for brownfields projects that insures participating developers and financial institutions against cost overruns from cleanups.

Based on research gathered during the information survey, the contractor team selected Lowell, MA to be one of the institutional frameworks case studies (Subtask 5.3) and is researching the State of Massachusetts' and the City of Lowell's brownfields redevelopment programs further as part of this case study. The contractor team will use information gathered on brownfields redevelopment approaches from

the information survey and case studies in the identification of institutional alternatives (Subtask 5.4) and in the funding and operational analyses of the institutional alternatives (Subtasks 5.7-8).

Next Steps

This memorandum completes the information survey; however, as discussed earlier, it does not complete the information gathering and learning that will inform the Project. Research, information gathering, and learning will continue during production of the remaining Project deliverables and as part of Task Force and Work Group meetings.

Based on their judgment, direction from Ecology, and suggestions and advice from Task Force and Work Group members, the contractor-team leads for Project tasks and sub-tasks may contact many of the individuals suggested by interviewees as follow-up contacts or may re-contact individual interviewees to ask questions relevant to specific Project deliverables or obtain other information. Primary uses of the information survey information that are currently planned are noted in the summary of key findings above. Additional uses will undoubtedly emerge as the Project unfolds. Outcomes of this iterative, on-going research will be reported, as appropriate, as part of producing specific Project deliverables rather than appended to this information survey.

Preliminary findings from the information survey were reviewed with the Area-Wide Soil Contamination Task Force at their April 2002 meeting. Based on Task Force suggestions, Internet-based research was conducted on: agricultural land-use conversion in Southern California, Florida, Illinois, and the Carolinas; a smelter clean up in Port Pirie, Australia; and efforts to address residual contamination from historic use of lead arsenate in the Canadian Provinces of Ontario and Nova Scotia in an effort to identify materials relevant to the Project and potential interview candidates. This research will continue and additional follow up, including requesting documents or other information and/or contacting representatives of appropriate agencies or sites, will continue. Outcomes of this research will likely be reported, as appropriate, as part of producing specific Project deliverables; however, if research on work in the Canadian Provinces (or at other sites) reveals area-wide contamination studies or projects, supplemental interviews will be conducted and appended to this information survey with the supplemental interviews identified below.

Ecology has requested two supplementary interviews to add to the information survey. Interviews will be scheduled with Shahid Mahmud (U.S. Environmental Protection Agency), who is a contact person for an EPA work group that is considering issues related to area-wide contamination at large-area cleanup sites across the country, and with Dave Williams (U.S. Environmental Protection Agency Region 8), who is assembling information on area-wide arsenic soil contamination in the greater Denver area and, along with an interagency work group, developing a preliminary plan to address the problem. In addition, the contractor-team will identify an appropriate contact with the U.S. Geological Survey study of arsenic levels in New England for a third supplemental interview. Contact summary sheets from these interviews will be appended to this survey as Appendix F and provided to the Task Force and Work Groups. Raw interview notes and any reference material gathered will be provided to the contractor-team leads for the Project analytic areas. Raw interview notes will also be provided to Ecology.

Appendix A:

Information Survey Process

The information survey was conducted according to the approach proposed in a memorandum to Ecology dated January 29, 2002, as well as subsequent recommendations from the Area-Wide Soil Contamination Task Force and chartering agencies. This earlier memorandum described proposed survey protocols; initial contacts in the sectors of research and academia, government, and non-governmental stakeholders; interview questions; and the content of the literature reviews in the project's analytical areas.

Interviews Conducted

The Area-Wide Soil Contamination Project consultant team conducted 22 phone interviews during February through April for the information survey. This included interviews with six contacts in research and academia, 11 government contacts, and six contacts from non-governmental organizations. Although we started by contacting the individuals and organizations listed in the January information survey memorandum, we identified alternative contacts and conducted additional interviews during the survey process where appropriate to address information gaps. The following tables list the contacts we interviewed.

Interviews Conducted with Contacts in Research and Academia

Name	Title	Organization	Affiliation/Expertise/Notes
Martin B. Goldhaber		U.S. Geological Survey, Arsenic Studies Group	Dr. Goldhaber is a member of the steering committee for the USGS Arsenic Studies Group and was recommended as a contact by Robert Wershaw of USGS.
Lena Q. Ma	Associate Professor in Soil/Environmental Chemistry	Soil & Water Science Department, University of Florida	Recently published paper on background concentrations of arsenic in Florida soil. Discovered brake fern as a phyto-remediation tool. Recommended by Frank Peryea as possible contact.
Ian Merwin	Associate Professor	Cornell University Department of Horticulture	Recommended by Frank Peryea as most active in the field concerning orchards.
Ravi Naidu	Program Leader	CSIRO, Remediation of Contaminated Environments Program	Dr. Naidu is a Senior Principal Research Scientist and Leader of the Remediation of Contaminated Environments Program at CSIRO, an Australian research institute. He was program chair for the 2001 Arsenic in Asia Workshop. His research interests include the fate and behavior of metal and organic contaminants and innovative techniques for remediating contaminated sites. Dr. Naidu was recommended by Frank Peryea.
Peter Veneman	Professor and Department Head	Department of Plant and Soil Sciences, University of Massachusetts	Dr. Veneman is head of the soil sciences department at UMass Amherst and has researched the distribution of lead and arsenic in Massachusetts' orchard soils. Referred by Frank Peryea.
Robert Wershaw		U.S. Geological Survey, Arsenic Studies Group	Dr. Wershaw is the contact person for the USGS Arsenic Studies Group.

Interviews Conducted with Contacts from Government			
Name	**Title**	**Organization**	**Affiliation/Expertise/Notes**
Mike Bellot		Environmental Protection Agency, Superfund Office	Mr. Bellot works in the Superfund Office at EPA headquarters. Before joining this office, he worked as a Remedial Project Manager for 10 years managing cleanups at specific sites, including sites with large areas of lead contamination such as the Phelps-Dodge smelter site in Douglas, AZ, and Verdese Carter Park near Oakland, CA. Greg Jordan of EPA Brownfields Office referred us to Mr. Bellot as a good contact for institutional controls and liability protection issues.
Jerry Cobb		Panhandle Health District, Idaho	Bunker Hill Mining and Metallurgical Site. Smelter operated between 1917 and about the 1970s. Lead is the primary constituent of concern (COC). It is one of the largest Superfund sites in the country. Many people have been involved. CDC, ASTDR studies. Greg Glass recommended Jerry Cobb.
Charlie Coleman		Environmental Protection Agency Region 8, Montana	Anaconda Ore Processing Facilities, Superfund Site, Anaconda, MT. Smelter and other facilities operated from about 1884 to 1980. Arsenic is the primary COC. Approximately 300 square miles are contaminated. Site suggested by Greg Glass.
Greg Jordan		Environmental Protection Agency, Outreach and Special Projects Staff (the Brownfields office)	Mr. Jordan works in the Brownfields office at EPA headquarters. He is an engineer and deals with technical issues related to brownfields, including institutional controls.
Robbie Morris		California Department of Toxics Substances Control (DTSC), Schools Property Evaluation and Cleanup Division	California is the only state that has enacted legislation that requires environmental screening and cleanup of proposed school sites. Robbie Morris is the point of contact for the California DTSC's Schools Property Evaluation and Cleanup Division.
Eileen Murphy and Kevin Schick		New Jersey Department of Environmental Protection	The NJ DEP did extensive work on the distribution and source of arsenic from agricultural activities; the final report was published in 1999. Ms. Murphy was a primary author of the refereed technical journals. Mr. Schick is the lead person at NJ DEP on historic pesticide contamination issues. Both people were involved with the Historic Pesticide Contamination Task Force.
Barbara O'Grady		Colorado Department of Public Health and Environment	Globeville Smelter and Vasquez Boulevard/I-70 sites near Denver, CO. The Globe Plant still operates, but no longer operates as a lead smelter or refines arsenic; it is a proposed Superfund site. Constituents of concern are arsenic, lead, cadmium, and zinc. About 550 homes remediated. There is a medical monitoring program. Referral from Greg Glass.
Michael Storck	Project Manager	Utah Department of Environmental Quality	Murray Smelter, Superfund Site, Murray, Utah. Lead smelter operated between 1872 and 1949. COCs are lead and arsenic. Site remediation and residential property remediation. Superfund site. Reference by Greg Glass with note about innovative institutional controls.
Wong Valesco		Arizona Department of Environmental Quality	Mr. Valesco works in the Arizona Department of Environmental Quality's Voluntary Remediation Program. Keith Ross of LSI Adapt who worked at the Arizona Department of Environmental Quality from 1989 to 1995 referred us to Mr. Valesco as someone who could tell us about Arizona DEQ's policies for dealing with contamination from legally applied pesticides.
Cheryl Yates		Kootenay Boundary Community Health Services, Trail, BC	The Trail, BC lead-zinc smelter has operated since the beginning of the 20th century. The Trail Community Lead Task Force was formed in 1990 with a goal of reducing children's blood lead levels; it completed its work in 2001. Cheryl Yates has been with the project since 1989 and manages the health, education, and case management services related to lead exposure for the Trail community.

Interviews Conducted with Contacts from Nongovernmental Organizations			
Name	**Title**	**Organization**	**Affiliation/Expertise/Notes**
Stuart Cameron	Executive Vice President and Director of Government Relations	New Jersey Bankers Association	Stuart Cameron participated in the New Jersey Historic Pesticide Contamination Task Force, which was formed to help identify technically and economically viable protective strategies for sites with widespread soil contamination due to pesticides use.
Mike Davidson		Research Department, American Planning Association	The American Planning Association is a public interest and research organization associated with the American Institute of Certified Planners.
Steven Hilts		Cominco, Inc., Trail, British Columbia	The Trail, BC lead-zinc smelter has operated since the beginning of the century. The Trail Community Lead Task Force was formed in 1990 with a goal of reducing children's blood lead levels; it completed its work in 2001. Mr. Hilts was the environmental manager for the Trail Lead Program starting in 1991; he continues to work at Cominco on issues related to the environmental impacts of the smelter's current and past emissions.
Megan Lewis		American Planning Association	The American Planning Association (APA) is a public interest and research organization associated with the American Institute of Certified Planners. Megan Lewis specializing in environmental issues for the APA and was referred to us by Mike Davidson of APA's Research Department.
Keith Ross	Senior Hydrogeologist	LSI Adapt	Jeff Andrilenas of the Area-Wide Soil Contamination Task Force suggested that we contact Mr. Ross, who worked at the Arizona Department of Environmental Quality from 1989 to 1995. When Mr. Ross was in Arizona, the Arizona DEQ was in the process of developing a formal policy for dealing with contamination from legally applied pesticides at former farmlands.
Elizabeth Stasiak	Project Manager, Brownfields Best Practices	International City/County Management Association	ICMA has extensively researched brownfields programs in the U.S. and around the world and works directly with local governments in the U.S.

We tailored the interview questions for these interviews to each contact, using the list of survey questions in the January memorandum as a starting point, and followed up with interviewees to request documents and obtain other information. For each interview, we prepared an interview summary that includes contact information for the interviewee, a description of the key points of the interview, and a list of suggested references and additional people to contact for further information. Raw interview notes were also kept.

Literature Reviewed

The project consultant team conducted literature reviews in each of the project's three analytical areas. We consulted a variety of types of sources, including:

- Primary and secondary research articles
- Government documents, such as regulations, policy guidance, educational materials, and research studies
- Reports and other materials produced for similar multi-stakeholder task force efforts

To complement the interviews conducted for the information survey, this was a broad-based research effort. We looked at what has been done in Washington state, other U.S. states, and other countries to investigate and/or address area-wide soil contamination or similar problems. We did not limit our

research to arsenic and lead soil contamination, but also looked at area-wide contamination from other contaminants. We studied efforts to characterize and/or address contamination at smelter sites and former agricultural areas, as well as mining sites, urban "brownfields," military properties, and other types of sites. Examples of the information researched include:

- Characterization studies
- Fruit and vegetable surveys
- Field and lab trials of remedial measures
- Land management strategies
- Funding resources
- Evaluations of institutional controls

The consultant team documented the results of the literature reviews in annotated bibliographies, organized by project analytical area. These bibliographies describe the information contained in each reference and its relevance to the Area-Wide Soil Contamination Project.

Appendix B:

Interview Contact Summary Sheets

Contact: Mike Bellot, Environmental Protection Agency, Superfund Office		**Interview Date:** 3/27/02 **Interviewers:** Jennifer Tice and Lori Ahouse
Category: Government	**Phone:** 703-603-8905	**E-Mail:** Bellot.Michael@epa.gov
Website: http://www.epa.gov/superfund/		

Affiliation/Expertise/Notes: Mr. Bellot works in the Superfund Office at EPA headquarters. Before joining this office, he worked as a Remedial Project Manager for 10 years managing cleanups at specific sites, including sites with large areas of lead contamination such as the Phelps-Dodge smelter site in Douglas, AZ, and Verdese Carter Park in Oakland, CA. Greg Jordan of EPA Brownfields Office referred us to Mr. Bellot as a good contact for institutional controls and liability protection issues.

Most Relevant to: __ Nature & Extent _X_ Protective Measures _X_ Institutional Frameworks
Specific deliverables: Protective measure alternatives, institutional alternatives, and institutional analysis

Key Points:

Lessons learned from cleanup experiences at the Phelps-Dodge smelter site in Douglas, AZ, and at Verdese Carter Park near Oakland, CA:

1. There were considerable anthropogenic sources of lead. "Background" lead levels were 500-800 ppm at the California site, and these were attributed to the nearby interstate.
2. Mr. Bellot recommends working with HUD and local governments to leverage resources and coordinate efforts to deal with lead issues as EPA did at the Verdese Carter Park site.
3. People had strong reactions to the sampling and cleanup activities. (They were afraid of what information the sampling would reveal, and it was difficult to get access for sampling. Some people were angry that children may have been exposed for a number of years; others were worried that their pensions would be affected if the smelter company left town.)

Recommendations for institutional controls (ICs):

- "Layer" the institutional controls—use multiple ICs at a site.
  - Each IC had a its own strengths and weaknesses, and may help achieve a different objective.
- Evaluate ICs the same way as any other remedy, including analyzing their costs.
- Enter into an agreement with local agencies to provide money to the local agencies for implementation, monitoring, and enforcement and to clarify roles and expectations.
  - Local governments are often responsible for implementing, monitoring, and enforcing ICs, but they may not be aware of these requirements or there may not be funding available.
- Carefully research the authorities for ICs and select the appropriate IC for those authorities.
  - For example, don't choose a zoning approach for an unincorporated area.
  - If the concern is excavation, choose an IC that an excavator would come across (such as a one-call system through a utility, rather than a deed restriction).
  - If the concern is with property transfer, ensure that an IC is in place that will show up in the property title (e.g., a covenant or easement).
- Don't close out enforceable agreements if there are ICs in place, or the ability to enforce them will be lost.

References / Referrals:

Suggested Contacts

- Shahid Mahmud, EPA, 703-603-8789 (EPA has assembled a work group, the large area sites group, to wrestle with the issues related to area-wide contamination. The group focuses on innovative approaches from both the risk evaluation and remedy point of view. Mr. Mahmud was suggested as the first person to contact about this group.)
- Scott Fredericks, EPA Emergency Response Team, 703-603-8771 (Mr. Bellot described Mr.

Fredericks as an expert on phyto-remediation who is becoming a biosolids expert. He is involved with pilot tests of these techniques to determine their strengths and weaknesses.)

- Nancy Riveland-Har, EPA Region 9, 415-972-3251 (Ms. Riveland-Har is a project manager for EPA who might have contact information for people at HUD and local governments who worked with EPA on the lead remediation/intervention efforts at the Verdese Carter Park site.)
- Alison Abernathy, EPA headquarters, 202-260-9925 (for information on ICs at federal facility sites)
- David Dorian, EPA headquarters, 703-308-3540 (for information on ICs from the RCRA context)
- Steve Hess, EPA Office of General Counsel, 202-564-5461 (for information on the legal aspects of ICs)
- Malcolm Woolf, EPA headquarters, 202-564-5562 (another contact for legal aspects of ICs, particularly at Superfund sites)
- Keith Sheff, EPA headquarters, 202-564-8213 (for information on enforcement of ICs)

Suggested Resources

- EPA webpage with information on ICs, including information on recent IC workshops, http://www.epa.gov/superfund/action/ic/index.htm
- Environmental Law Institute (ELI), website: http://www.eli.org/ (ELI has done a lot of work for the Department of Energy and EPA, including a 50-state study on ICs.)
- Department of Energy's Office of Long-Term Stewardship website: http://lts.apps.em.doe.gov/
- Resources for the Future (RFF) website: http://www.rff.org/
- ICMA (International City/County Management Association) website: http://www.icma.org (ICMA has done a lot of work on ICs.)

Follow-up:	**Person Responsible:**
Interview Shahid Mahmud about EPA's large-area sites work group.	Jennifer Tice

Contact: Stuart Cameron, Executive Vice President and Director of Government Relations, New Jersey Bankers Association		**Interview Date:** 2/20/2002 **Interviewer:** Jennifer Tice
Category: Nongovernmental stakeholder	**Phone:** 609-520-1221	**E-Mail:** scameron@njbankers.com
Website: New Jersey Historic Pesticide Contamination Task Force, http://www.state.nj.us/dep/special/hpctf/index.html		
Affiliation/Expertise/Notes: Stuart Cameron participated in the New Jersey Historic Pesticide Contamination Task Force, which was formed to help identify technically and economically viable protective strategies for sites with widespread soil contamination due to pesticides use.		
Most Relevant to: __ Nature & Extent _X_ Protective Measures _X_ Institutional Frameworks *Specific deliverables:* Alternatives, costs, and health assessments of protective measure alternatives (see final report for more details, though); institutional alternatives; and legal, funding, and operational analyses of institutional alternatives. (Note: This is also relevant to Task 2, the Task Force Facilitation Task, since it sheds light on what happened during the deliberations of a similar task force.)		
Key Points: • The bottom line for the New Jersey Historic Pesticide Contamination Task Force was that the alternatives for addressing historic pesticide contamination needed to be balanced and pragmatic. • The NJ task force found that, in most cases, soil blending is the best option. However, Mr. Cameron noted that the technology for treating contamination may have advanced since the task force did its work (1997–99), so there might be other practical alternatives. • The NJ task force tied the choice of land-use/institutional controls to the remedy selected at a site. Mr. Cameron described examples where there were more strict land-use controls (e.g., deed restrictions) in cases where remedies relied more heavily on engineering controls. • New Jersey's lender liability laws have been very important in protecting banks and allowing them to cooperate with the investigation and cleanup of contaminated sites. • State cleanup standards need to be clear and reasonable; the tougher the standards, the more funds the state should have available for assistance. • Mr. Cameron thought individuals, and the marketplace, should have a large role in addressing issues of historic pesticide contamination. While banks should have standards in their lending practices and realtors should provide information to consumers, consumers also have some responsibility for protecting themselves.		
References / Referrals: Available at http://www.state.nj.us/dep/special/hpctf/index.html: • Historic Pesticide Contamination Task Force, *Final Report: Findings and Recommendations for the Remediation of Historic Pesticide Contamination,* March 1999. • Homeowner's Fact Sheet		
Follow-up: Interviewed Eileen Murphy and Kevin Schick of the New Jersey Department of Environmental Protection and contacted other members of the New Jersey task force (Jane Nogaki and Pat Halbe) for additional perspectives. No additional follow-up required.		**Person Responsible:**

Contact: Jerry Cobb, Panhandle Health District, Idaho		**Interview Date:** 2/19/2002 **Interviewers:** Jennifer Tice and Lori Ahouse
Category: Government	**Phone:** 208-783-0707	**E-Mail:** phdicp@dmi.net
Website: http://yosemite.epa.gov/R10/CLEANUP.NSF/webpage/Bunker+Hill+Mining+and+Metallurgical		
Affiliation/Expertise/Notes: Bunker Hill Mining and Metallurgical Site. Smelter operated between 1917 and about the 1970s. Lead is the primary constituent of concern (COC). It is one of the largest Superfund sites in the country. Many people have been involved. CDC, ASTDR studies. Greg Glass recommended Jerry Cobb.		
Most Relevant to: __ Nature & Extent _X_ Protective Measures _X_ Institutional Frameworks *Specific deliverables:* Identification and analyses of protective measure alternatives and institutional alternatives. Potential institutional frameworks case study.		
Key Points: • The Bunker Hill site tries to use a comprehensive, "cradle-to-grave" approach to risk management. Components of the program include education, data collection, enforcement, running a landfill, licensing contractors, incentives for homeowners to dispose of and replace contaminated soil, soil removal, an administrative system, and integration with local planning and zoning. • This has been an extensive, multi-year effort involving community members, the mining company, local governments, and the Panhandle Health District, a special purpose district that does work under contract from the State of Idaho and EPA. • The Bunker Hill Superfund Task Force, which consists of local citizens, decided on three principles, by which all elements of the remediation and institutional control plan would be evaluated. Those principles consisted of: 1. Minimize inconvenience and cost for homeowners 2. Use existing controls and local agencies to the maximum extent possible 3. The institutional control program should be self-sustaining and should not impose significant costs on homeowners		
References / Referrals: For additional information on the Bunker Hill site, contact: • Rob Hanson, state program manager, 208-373-0290, rhanson@deq.state.id.us (He came on soon after Institutional Control Program was adopted; start with him.) • Terry Douglas, city councilman for the City of Douglas <u>Documents received:</u> • Contaminant Management Rules for Bunker Hill institutional control program • Brochures about the Bunker Hill institutional controls program		
Follow-up: Requested and received additional documents on the institutional control program at Bunker Hill. Site selected as one of the institutional frameworks case studies. Contact Mr. Cobb and/or referrals as necessary to gather information to support the case study.		**Person Responsible:** Jennifer Tice or Lori Ahouse

Contact: Charlie Coleman, Environmental Protection Agency Region 8, Montana		**Interview Date:** 2/22/2002 **Interviewers:** Jennifer Tice & Elizabeth McManus
Category: Government	**Phone:** 406-457-5038	**E-Mail:** coleman.charles@epa.gov
Website: http://www.epa.gov/region08/superfund/sites/mt/anacon.html		
Affiliation/Expertise/Notes: Anaconda Ore Processing Facilities, Superfund Site, Anaconda, MT. Smelter and other facilities operated from about 1884 to 1980. Arsenic is the primary COC. Approximately 300 square miles are contaminated. Site suggested by Greg Glass.		
Most Relevant to: _X_ Nature & Extent __ Protective Measures _X_ Institutional Frameworks *Specific deliverables:* sampling protocols/guidance, tools for identifying area-wide contamination (kriging model), and institutional alternatives (development permit system, education & communication program). Potential institutional frameworks case study.		

Key Points:

- The EPA oversaw a large effort to sample soils and use a data kriging model to estimate arsenic levels within a 10-mile radius of the Anaconda smelter.
  - There was a lot of variation in the data, depending on topography and whether the sampling area had been disturbed (e.g., along roads).
  - The kriging model turned out to be farirly predictive of lead and arsenic concentrations.
- EPA has developed a number of sampling protocols and strategies for the Anaconda site, including a sampling protocol for residential yards.
- EPA used a site-specific risk assessment approach--including bioavailability studies--to establish an action level for arsenic of 250 ppm for residential yards, which EPA believes represents an 8x10(-5) risk level. Based on sampling, high arsenic concentrations appear to be associated with high lead concentrations, so remediation based on arsenic concentrations will automatically address high lead concentrations.
- The County created a special land-use district and established a development permit system for the Superfund district area. (Mr. Coleman noted that many aspects of this development permit system, and the institutional control program in general, still needed to be resolved.)
- Local banks, lenders, and realtors, as well as EPA, have been involved in the community involvement and education program for the site, which has been working well, but needs to be institutionalized. They are developing "information packages" for developers and homeowners.
- In rural areas, where there is arsenic soil contamination, there also is arsenic ground-water contamination, especially in shallow areas. Managers are considering establishing a ground-water control area near the Anaconda site.

Lessons learned from experience with institutional controls:

- Clean up sites as much as possible before using institutional controls (because of risks involved).
- The potentially responsible party or EPA may need mechanisms to ensure that communities implement institutional controls. Restrictive covenants, for example, should include a "hammer" that the property could revert to the PRP if the covenants are not followed.

References / Referrals:

For information on other sites, contact:

- Sarah Sparks, EPA Remedial Project Manager, 406-782-7415 (for Butte, MT site, which is further along with institutional controls)
- Scott Brown, EPA project manager, 406-457-5035 (for E. Helena, MT site, which has a lead abatement program)

- Wendy Thomi, EPA, 406-457-5037 (for Libby, MT site, concerning community relations)

For more on the Anaconda, MT site, contact:

- Jim Davidson, with the local development corporation, 406-563-5538 (ask him for the information package for developers)

Documents Received:

- Anaconda Community Soils Record of Decision
- Anaconda Human Health Risk Assessment
- Draft Institutional Controls Preliminary Design Package
- Draft Final Sampling and Analysis Plan for Residential Soils

Follow-up:	**Person Responsible:**
Requested and received supporting materials. No additional follow-up required at this time.	

Contact: Mike Davidson, Research Department, American Planning Association		**Contact Date:** 2/20/02 **Caller:** Jennifer Tice
Category: Nongovernmental Organization	**Phone:** 312-786-6352	**E-Mail:** (Not available)
Website: http://www.planning.org/		
Affiliation/Expertise/Notes: The American Planning Association is a public interest and research organization associated with the American Institute of Certified Planners.		
Most Relevant to: __ Nature & Extent __ Protective Measures __ Institutional Frameworks *Specific deliverables:* None.		
Key Points: [Mr. Davidson explained that the American Planning Association (APA) provides a subscription-based research service. He couldn't answer our questions without charging research fees, so instead he suggested other people we might contact.]		
References / Referrals: Mr. Davidson suggested two additional contacts at APA who have environmental specialties and may be able to suggest case studies for our research. • Megan Lewis, mlewis@planning.org • Jim Schwab, jschwab@planning.org		
Follow-up: Contacted Megan Lewis, who suggested additional lines of research on institutional frameworks case studies. No additional follow up required.		**Person Responsible:**

Contact: Martin B. Goldhaber, U.S. Geological Survey, Arsenic Studies Group		**Contact Date:** 3/5/02 **Caller:** Jennifer Tice
Category: Research	**Phone:** 303-236-1521	**E-Mail:** mgold@usgs.gov
Website: http://wwwbrr.cr.usgs.gov/Arsenic/index.htm		
Affiliation/Expertise/Notes: Dr. Goldhaber is a member of the steering committee for the USGS Arsenic Studies Group and was recommended as a contact by Robert Wershaw of USGS.		
Most Relevant to: _X_ Nature & Extent __ Protective Measures __ Institutional Frameworks *Specific deliverables:* preliminary estimates, variations in natural background concentrations		

Key Points:

There are 200-300 people at USGS working on arsenic issues. Mr. Goldhaber described a few ongoing studies that might be the most applicable to the Area-Wide Soil Contamination Project:

- There is a major USGS study on arsenic soil contamination going on in New England, which has both a history of lead arsenate pesticide use and high natural background concentrations of arsenic (contact Joseph Ayotte for more information).
- Another USGS group is looking at the use of lead isotopes as a tracer for lead in lead arsenate to distinguish between natural background levels and anthropogenic soil contamination from lead arsenate (contact Robert Ayuso for more information). Mr. Goldhaber explained that most of the lead that was used in leaded gasoline, lead arsenate pesticides, and other products in the U.S. (that may have ended up as anthropogenic soil contamination) originated from a particular site in Missouri, and that this Missouri lead has a distinctive isotopic form so can be used as a tracer.
- There is a group looking at selected leaches of contaminants (including arsenic)—specifically, at leaches that mimic natural flows (e.g., like intestinal flows) (contact Geoffrey Plumlee for more information). Mr. Goldhaber thought that this research might be relevant to understanding how body fluids act on arsenic (and other contaminants) from soil ingestion.

References / Referrals:

Contacts

- Joseph Ayotte, USGS (New England), jayotte@usgs.gov, 603-226-7810 (involved in New England USGS study)
- Robert A Ayuso, USGS (Reston, VA), rayuso@usgs.gov, 703-648-6347 (leading the study on using lead isotopes to distinguish between background concentrations and anthropogenic contamination)
- Geoffrey S Plumlee, USGS (Denver, CO), gplumlee@usgs.gov, 303-236-1204 (he's working on selected leaches)
- Alan H Welch, Hydrologist, USGS (Carson City, NV), ahwelch@usgs.gov, 775-887-7609 (best contact for USGS studies on arsenic in ground water)

Documents

- Frank J. Peryea, 1989; Leaching of Lead and Arsenic in Soils Contaminated with Lead Arsenate Pesticide Residues, Project Completion Report Submitted to: The State of Washington Water Research Center and U.S Dept. of the Interior; U.S. Dept. of the Interior Water Research Center project NO A-158-Wash. U.S. Dept of the Interior Grant G1597; 50 pp.
- Walter Ficklin et al. 1989; Analytical results for water, soil and rocks collected near Granite Falls, Washington as part of an arsenic in groundwater study. USGS open file report 89-148
- Background soils data: Gustiavsson, et al., Geochemical Landscapes of the Conterminous United States- New Map Presentations for 22 elements. USGS Professional paper 1648; Available online at http://geology.cr.usgs.gov/pub/ppapers/p1648/

Follow-up: Contact Joseph Ayotte to obtain more information on the USGS arsenic study in New England.	**Person Responsible:** Jennifer Tice

Contact: Steven Hilts, Teck Cominco, Inc., Trail, British Columbia		**Interview Date:** 2/26/2002 **Interviewers:** Jennifer Tice and Elizabeth McManus
Category: Nongovernmental	**Phone:** 250-364-4385	**E-Mail:** Steven.Hilts@teckcominco.com
Website: Trail Community Lead Task Force, http://mypage.direct.ca/t/tlp/index.html		

Affiliation/Expertise/Notes: The Trail, BC lead-zinc smelter has operated since the beginning of the century. The Trail Community Lead Task Force was formed in 1990 with a goal of reducing children's blood lead levels; it completed its work in 2001. Mr. Hilts was the environmental manager for the Trail Lead Program starting in 1991; he continues to work at Teck Cominco (the smelter operator) on issues related to the environmental impacts of the smelter's current and past emissions.

Most Relevant to: __ Nature & Extent _X_ Protective Measures __ Institutional Frameworks
Specific deliverables: Protective measure alternatives, cost analysis, and institutional analysis. Potential institutional frameworks case study.

Key Points:

- The Trail Lead Program's case management program, with its one-on-one consultation and targeted interventions at people's residences, has helped reduce children's blood lead levels.
  - Case management activities can include soil removal and replacement, assistance with soil cover, and the purchase of vacuum cleaners.
  - Mr. Hilts reported that there is less evidence that the broader educational effort has had significant impacts.
- Cominco is currently involved with the Geological Survey of Canada in an effort to study natural background concentrations of lead and arsenic in the area and to differentiate between natural and smelter-related contamination near the Trail smelter.
- The Trail Lead Program and Lead Task Force considered a variety of remedial options for addressing soil contamination (which doesn't appear to be as important to children's health as are current smelter emissions) including:
  - soil amendment *in situ*, using phosphate and iron (Lab trials, but not field trials, of this technique were successful in reducing lead and arsenic concentrations.)
  - soil removal and replacement (The community did not support this option, which was found to be very costly, especially given the topography of the valley.)
  - phyto-extraction (Though it could be effective, this was found to not be a practical option for residential properties.)
  - planting/maintaining groundcover and other dust control measures (This is ultimately what the Task Force recommended, combined with emissions reductions, health and environmental monitoring, education, and case management.)

References / Referrals:

Website:

- EPA's Remedial Technologies Demonstration Forum (RTDF), www.rtdf.org

Contacts:

- Mark Doolan, EPA in Kansas City, MO, doolan.mark@epa.gov, 913-551-7169 (for information on the Joplin, MO site; portable XRF technology; *in situ* soil amendment; and cost-effective means to remove soil)
- Sally Brown, a soil scientist at the University of Washington (for information on the RTDF group, Missouri sites, and Bunker Hill, ID)

Documents Received:

- Final Report of the Trail Lead Task Force: Trail Lead Program, *Identification, Evaluation and Selection of Remedial Options*, January 2001.
- Summary of Trail Community Lead Task Force Budget (Excel spreadsheet)
- Site Characterization, Final Report, 1995.
- Exposure Pathways Investigations, Final Report, 1995.
- HEPA House Cleaning Pilot Project, Final Report, 1994.
- Eco Risk Study Update, February 2002.
- Goodarzi, F. et al. "Preliminary Assessment of Background Concentrations of Elements in Soil from the Trail Area." December 2001.
- "Evaluation of New Data and Determination of Contaminants of Potential Concern"
- "Health Risk Management in an Active Lead/Zinc Smelter Community," *BC Health and Disease Surveillance*, 30 April 1998.
- Hilts, Steven R. "A Co-operative Approach to Risk Management in an Active Lead/Zinc Smelter Community." *Environmental Geochemistry and Health* (1996), 18, 17-24.
- Hilts, Steven R., et al. "A Controlled Trial of the Effect of HEPA Vacuuming on Childhood Lead Exposure." *Canadian Journal of Public Health.* (September-October 1995), 345-50.
- Hilts, Steven R., et al. "Effect of Interventions on Children's Blood Lead Levels." *Environmental Health Perspectives* 106 (February 1998), 79-83.

Additional Documents We Could Request

(Executive summaries are viewable on-line at http://mypage.direct.ca/t/tlp/page5.html).

- Baseline Risk Assessment for Childhood Lead Exposure
- Street Cleaning Study
- Ground Cover Subsidy Study
- Community Dust Abatement Projects Report
- Community Blood Lead Status Report
- Human Health Risk Assessment for Other Smelter Contaminants

Follow-up:	**Person Responsible:**
Requested and received supporting documents; no additional follow up required.	

Contact: Greg Jordan, Environmental Protection Agency, Outreach and Special Projects Staff (the Brownfields office)		**Interview Dates:** 3/7/02 and 3/8/02 **Interviewers:** Jennifer Tice & Elizabeth McManus
Category: Government	**Phone:** 202-260-4873	**E-Mail:** Jordan.Greg@epamail.epa.gov
Website: http://www.epa.gov/brownfields/		
Affiliation/Expertise/Notes: Mr. Jordan works in the Brownfields office at EPA headquarters. He is an engineer and deals with technical issues related to brownfields, including institutional controls.		
Most Relevant to: __ Nature & Extent __ Protective Measures _X_ Institutional Frameworks *Specific deliverables:* Institutional alternatives and institutional analysis		

Key Points:

- One of the major issues associated with institutional controls is tracking and accountability.
- While there are a range of experiences in individual states, preliminary results of an EPA study on state and local tracking systems for institutional controls highlight a number of concerns with institutional controls in practice:
  - Data on institutional controls at properties are not easily accessible to the public.
  - There is little routine monitoring of institutional controls; problems come as surprises.
  - Institutional controls often contain imprecise, unclear language.
  - Institutional controls are often assigned to an entire parcel rather than a specific part of the parcel where contamination may be a problem.
- EPA is planning further studies of institutional control approaches in individual states and some pilot projects in an effort to identify more precisely any problems with institutional controls and examine best practices for institutional controls.
- The Small Business Liability Relief and Brownfields Revitalization Act, which was enacted in December, establishes for the first time a funding source specifically for brownfields redevelopment and provides additional liability protection for small businesses.

References / Referrals:

- Mike Bellot, EPA, 703-603-8905 (Mr. Bellot works in the Superfund office and commissioned a report on state tracking systems for institutional controls. Mr. Jordan suggested him as a good contact for institutional controls and liability protection issues.)
- Bruce Sean Reshen, President and CEO, MGP Environmental Partners, LLC, 203-399-6628, or Dan Alper, Chief Operation Officer, MGP Environmental Partners, LLC, 215-998-7856 (for information on a pilot study with the Pennsylvania DEP to establish a private trust fund to finance brownfields redevelopment)
- EPA webpage with information on institutional controls, http://www.epa.gov/superfund/action/ic/index.htm (Mr. Jordan referred us to the information on the San Antonio IC workshop and the fact sheet, in particular.)

Follow-up:	**Person Responsible:**
Interviewed Mike Bellot of EPA's Superfund Office. No additional follow-up required at this time.	

Contact: Megan Lewis, American Planning Association		**Contact Date:** 3/14/02 **By:** Jennifer Tice (e-mail)
Category: Nongovernmental Organization	**Phone:** 312-431-9100	**E-Mail:** MLewis@planning.org
Website: http://www.planning.org/		
Affiliation/Expertise/Notes: The American Planning Association (APA) is a public interest and research organization associated with the American Institute of Certified Planners. Megan Lewis specializing in environmental issues for the APA and was referred to us by Mike Davidson of APA's Research Department.		
Most Relevant to: __ Nature & Extent __ Protective Measures _X_ Institutional Frameworks *Specific deliverables:* Institutional alternatives and case studies.		
Key Points: [We asked Ms. Lewis specifically for suggestions of local government cleanup or redevelopment projects that might make good institutional frameworks case studies; she referred us to the following sources.]		
References / Referrals: • *Brownfields Site Redevelopment Assistance Act (S. 1079).* This act is now in front of the Senate Environment and Public Works Committee (EPW). There may be research out there in support of this legislation, which is being considered to allow communities to not only clean up sites, but also make them "part of a broader economic development plan" that would have a "multiplier" effect on federal investments in brownfield remediation. This may also be a source of case studies. • EPA Brownfields Site: http://www.epa.gov/swerosps/bf/success.htm. There are many case studies on this site. • The Dept of Energy's Center of Excellence for Sustainable Development website, http://www.sustainable.doe.gov/, which also has case studies.		
Follow-up: Interviewed Greg Jordan of EPA's Brownfields Program; no additional follow up required.		**Person Responsible:**

Contact: Lena Q. Ma, Associate Professor in Soil/Environmental Chemistry, Soil & Water Science Department, University of Florida		**Interview Date:** 2/20/2002 **Interviewer:** Jennifer Tice
Category: Research	**Phone:** 352-392-9063	**E-Mail:** lqma@ufl.edu
Website: http://www.ifas.ufl.edu/~qma/LQMa.html		
Affiliation/Expertise/Notes: Recently published paper on background concentrations of arsenic in Florida soil. Discovered brake fern as a phyto-remediation tool. Recommended by Frank Peryea as possible contact.		
Most Relevant to: _X_ Nature & Extent _X_ Protective Measures __ Institutional Frameworks *Specific deliverables:* range of protective measure alternatives, variation in background levels		

Key Points:

[Dr. Ma only briefly described her research, which includes studies on arsenic in Florida soils and on phytoremediation, and suggested that we review the list of publications available on her homepage.]

Dr. Ma has written a paper on phytoremediation involving the brake fern. Her work is not at the application stage, however. She doesn't have protocols developed for how to use it.
Her research group is doing an ongoing demonstration of the phytoremediation that involves 400 plants. The plants can take up several thousand parts per million of arsenic. She's is the process of analyzing the data now.

References / Referrals:

- Mike Blaloch, Eden Space, edenspace.com (regarding commercial applications of phytoremediation)
- She also suggested that we interview Frank Peryea.

Follow-up:	**Person Responsible:**
None required.	

Contact: Ian Merwin, Associate Professor, Cornell University Department of Horticulture		**Contact Date:** 2/8/2002 **Caller:** Jennifer Tice
Category: Research	**Phone:** 607-255-1777	**E-Mail:** im13@cornell.edu
Website: http://www.hort.cornell.edu/merwin/		
Affiliation/Expertise/Notes: Recommended by Frank Peryea as most active in the field concerning orchards.		
Most Relevant to: _X_ Nature & Extent __ Protective Measures __ Institutional Frameworks *Specific deliverables:* None.		
Key Points: [Mr. Merwin said that this is not an active area of research for him. He said he would review our list of interview questions and think about whom at Cornell would be the most appropriate for us to talk to.]		
References / Referrals: • Mr. Merwin said the real expert on this topic is Frank Peryea. • In terms of people at Cornell University, Mr. Merwin said there was a group that is looking at sludge and mentioned Don Lisk as a potential contact. <u>Reference Obtained:</u> • Merwin, I.A., P.T. Pruyne, J.G. Ebel, Jr., K.L. Manzell, and D.J. Lisk. 1994. Persistence, phytotoxicity, and management of arsenic, lead and mercury residues in old orchard soils of New York. Chemosphere 29:1361-1367.		
Follow-up: Requested and received research paper; no additional follow-up required.		**Person Responsible:**

Contact: Robbie Morris, California Department of Toxics Substances Control (DTSC), Schools Property Evaluation and Cleanup Division		**Interview Date:** 2/26/2002 **Interviewers:** Jennifer Tice and Lori Ahouse
Category: Government	**Phone:** 818-551-2941	**E-Mail:** rmorris@dtsc.ca.gov
Website: http://www.dtsc.ca.gov/Schools/Schools.html		
Affiliation/Expertise/Notes: California is the only U.S. state that has enacted legislation that requires environmental screening and cleanup of proposed school sites. Robbie Morris is the point of contact for the California DTSC's Schools Property Evaluation and Cleanup Division.		
Most Relevant to: _X_ Nature & Extent __ Protective Measures _X_ Institutional Frameworks *Specific deliverables:* Sampling guidance, institutional alternatives, and institutional analysis.		

Key Points:

In California's Schools Property Evaluation and Cleanup Program, any school district that would like to receive state funding for construction (including remodeling) or acquisition of schools needs to do an environmental review of the proposed sites and undertake any necessary cleanup under DTSC oversight.

- The school district must complete a Phase I environmental assessment and, if contamination may be present, a Preliminary Endangerment Assessment (PEA).
- These are submitted to the California Department of Education and then DTSC for review and approval.

Lessons learned from DTSC's experience designing and implementing its Schools Property Evaluation and Cleanup Program include:

- DTSC has found that developing guidance documents for common situations (notably sites that were formerly agricultural and sites contaminated only with lead from lead-based paint) and streamlining the requirements for documenting the environmental evaluation of those properties has increased efficiency and added flexibility to the program.
- In implementing a program like this, the state agency needs to be flexible to local needs without compromising its policies that protect human health and the environment.

References / Referrals:

- Guidance documents for sampling agricultural soils and for evaluating lead-based paint contamination at proposed school sites, available at http://www.dtsc.ca.gov/Schools/Schools.html
- Preliminary Endangerment Assessment Guidance Manual (received in the mail)

Follow-up:	**Person Responsible:**
Requested and received supporting document; no additional follow-up required.	

Contact: Eileen Murphy and Kevin Schick, New Jersey Department of Environmental Protection		**Interview Date:** 2/26/2002 **Interviewers:** Jennifer Tice and Elizabeth McManus
Category: Government	**Phone:** Eileen Murphy: 609-633-2342, Kevin Schick: 609-984-1825	**E-Mail:** emurphy@dep.state.nj.us, KSCHICK@dep.state.nj.us
Websites: New Jersey DEP Site Remediation Program, http://www.state.nj.us/dep/srp/index.htm NJ Historic Pesticide Contamination Task Force, http://www.state.nj.us/dep/special/hpctf/index.html		
Affiliation/Expertise/Notes: The NJ DEP did extensive work on the distribution and source of arsenic from agricultural activities; the final report was published in 1999. Ms. Murphy was a primary author of the refereed technical journals. Mr. Schick is the lead person at NJ DEP on historic pesticide contamination issues. Both people were involved with the Historic Pesticide Contamination Task Force.		
Most Relevant to: _X_ Nature & Extent __ Protective Measures _X_ Institutional Frameworks *Specific deliverables:* Preliminary estimates, regional variations in background concentrations, and the identification and analysis of institutional alternatives. (There is additional information relevant to all analytical areas, including analysis of protective measure alternatives, in the task force's final report.)		

Key Points:

Background on New Jersey Cleanup Programs

- In the New Jersey cleanup programs, action, including evaluative action, is triggered only by development. There is currently no effort to systematically evaluate already developed former agricultural lands and the New Jersey task force did not consider the issue of already developed lands.
- When cleanup is needed, it is achieved by running sites through the existing voluntary cleanup program in New Jersey.
- When residential cleanup standards are not achieved, there is generally some form of capping. New Jersey DEP has a so-called "cap cop" who periodically inspects caps at these sites.

Nature and Extent of Contamination

- Arsenic (not lead) contamination is often a problem at sites with historic pesticide contamination in New Jersey, but the chemical dieldrin rather than arsenic is typically the driver for cleanup actions.
- The New Jersey DEP has studied natural background concentrations of arsenic in the state, as well as arsenic concentrations at former agricultural sites, and found that arsenic levels vary considerably across the state.

Protective Measures/Institutional Frameworks

- The Historic Pesticide Contamination Task Force found that deed notices, caps, and soil blending were the most cost-effective means to address historic pesticide contamination.
- New Jersey has had different experiences with two types of institutional controls—deed notices and deed restrictions.
    - Deed restrictions, which don't include any mechanism for monitoring or enforcement, have not been very effective in New Jersey's experience.
    - Deed notices, unlike deed restrictions, are part of the documentation for property titles. The NJ DEP has changed its technical regulations to require deed notices for site remediation projects at non-residential sites and biennial certification of whether institutional controls and engineering controls are being properly maintained.

Referrals:

- Jane Nogaki, New Jersey Environmental Federation, 856-767-1110 (She participated on the task

force and could refer us to local government contacts in Evesham or Mt Laurel Townships.)

- Mike Tompkins, Case Manager, New Jersey DEP, Site Remediation Program, 609-584-4166 (He does a lot of the work on farm sites.)

References:

- Kevin Schick, "Selected Sites with Potentially Naturally Occurring Elevated Background Arsenic and/or Beryllium Levels." [Obtained by e-mail.]
- New Jersey's Technical Requirements for Site Remediation and Deed Notice Guidance Document, available at http://www.state.nj.us/dep/srp/forms/deed_notice/index.html
- Fields, T., McNevin, T., Harkov, R. and Hunter, J., 1993. A summary of selected soil constituents and contaminants at background locations in New Jersey. NJ DEP Publication.
- Historic Pesticide Contamination Task Force, *Final Report: Findings and Recommendations for the Remediation of Historic Pesticide Contamination*, March 1999, available at http://www.state.nj.us/dep/special/hpctf/index.html.
- Hamilton, L., 1998. Arsenic and Lead Contaminated Soil Due to Historic Pesticide Use: National Survey Results, Conducted for the Division of Science and Research, NJ DEP. [received]

Follow-up:	**Person Responsible:**
Requested and received supporting documents. Contacted Jane Nogaki and identified local government contacts in Mount Laurel and Burlington Townships to interview as part of an institutional frameworks case study. No additional follow-up required for the information survey.	

Contact: Ravi Naidu, Program Leader, Remediation of Contaminated Environments Program, CSIRO, Australia		**Interview Date:** 3/19/02 **Interviewers:** Jennifer Tice & Elizabeth McManus
Category: Research	**Phone:** (011) 61-8-8303-8436	**E-Mail:** Ravi.Naidu@csiro.au
Website: http://www.clw.csiro.au/research/remediation/		
Affiliation/Expertise/Notes: Dr. Naidu is a Senior Principal Research Scientist and Leader of the Remediation of Contaminated Environments Program at CSIRO, an Australian research institute. He was program chair for the 2001 Arsenic in Asia Workshop. His research interests include the fate and behavior of metal and organic contaminants and innovative techniques for remediating contaminated sites. Frank Peryea recommended Dr. Naidu as a contact.		
Most Relevant to: _X_ Nature & Extent _X_ Protective Measures __ Institutional Frameworks *Specific deliverables:* preliminary estimates, protective measure alternatives		

Key Points:

Nature of Arsenic Contamination

- Australia has large areas of diffused arsenic soil contamination at orchards and along rail tracks; concentrations range from 50 ppm to 1000 ppm. There are also dip sites, which were used to get rid of lice or ticks in cattle and sheep, where arsenic concentrations are up to 2000 ppm.

Fate and Dynamics of Arsenic

- Dr. Naidu has found in his research both synergistic and non-synergistic effects of arsenic and organochlorides on soil binding and soil microbes.
- Uptake of arsenic in vegetables varies considerably by the type of vegetables. Dr. Naidu found levels of arsenic in most vegetables ranged from .5 ppm to 4 ppm, but radishes had concentrations of 70 ppm and another root crop (peeled) had concentrations up to 120 ppm.
- Dr. Naidu has studied and quantified correlations between the mobility of arsenic and partitioning coefficients of soil, and has found that there is more migration of arsenic and more uptake by vegetables in soils with higher pH (less acidic soils).

Remediation Strategies

- The CSIRO Contaminated Environments Program is doing research on *in situ* remediation, soil washing techniques, and phyto-remediation. With *in situ* remediation, Dr. Naidu is trying to develop a strategy for immobilizing arsenic with a cocktail of chemicals that will depend on the soil type and level of arsenic contamination.
- Dr. Naidu had two recommendations for addressing area-wide soil contamination
  - Dilute the site by mixing the contaminated soil with soil that has a high binding capacity.
  - Restrict the land uses on the site (for example, converting a site into a parking lot, growing trees but not wheat crops on a site)

References / Referrals:

Requested (on 4/4/02) papers Dr. Naidu submitted recently on:

- fate and dynamics of arsenic at sites with long-term contamination (including diffused contamination at orchards and rail tracks)
- effects of arsenic and organochlorides on soil binding and microbial characteristics of soil

Follow-up: Follow-up with document request, if needed.	**Person Responsible:**

Contact: Barbara O'Grady, Colorado Department of Public Health and Environment		**Interview Date:** 2/19/2002 **Interviewer:** Jennifer Tice
Category: Government	**Phone:** 303-692-3395	**E-Mail:** barbara.ogrady@state.co.us
Website: http://www.cdphe.state.co.us/hm/rpglobe.asp		
Affiliation/Expertise/Notes: Globeville Smelter and Vasquez Boulevard/I-70 sites near Denver, CO. The Globe Plant still operates, but no longer operates as a lead smelter or refines arsenic; it is a proposed Superfund site. Constituents of concern are arsenic, lead, cadmium, and zinc. About 550 homes remediated. There is a medical monitoring program. Referral from Greg Glass.		
Relevant to: _X_ Nature & Extent _X_ Protective Measures __ Institutional Frameworks *Specific deliverables:* Potentially relevant to many deliverables, including tools for identifying area-wide contamination, range of protective measure alternatives, cost issue paper, identification of institutional alternatives, and funding/operational analysis of institutional alternatives. Potential institutional frameworks case study.		

Key Points:

- The State manages the cleanup at the Globeville site, including the removal and replacement of soil in residential areas (which is mostly complete), a medical monitoring program, and a community information effort. (EPA oversees management of the Vasquez Boulevard/I-70 site.)
- The Colorado Department of Public Health and Environment has found some surprising results in sampling concentrations of arsenic outside the Globe and I-70 sites – specifically, in a pilot study, the Department found elevated levels of arsenic considerable distances from the smelter (e.g., 200 ppm arsenic 18 miles from the smelter).
- The Department, the City and County of Denver, and EPA have formed a work group to gather information on this potentially widespread arsenic contamination and develop a preliminary plan to address it. However, funding sources are uncertain, and soil removal will probably not be a reasonable option if the problem affects a large metropolitan area.

References / Referrals:

For information on costs of remedies, contact:

- Fonda Apostalofulos, engineer at CO Dept of Public Health and Environment, 303-692-3411

For research related to the nature & extent of contamination and natural background levels, contact:

- John Drexel, University of Colorado, 303-735-4953

For more information on the I-70 site, contact:

- Bonnie LaVelle, EPA project manager, 303-312-6579

For information on the larger, area-wide issues of arsenic contamination in the greater Denver area, contact:

- Dave Williams, EPA Region 8
- Celia Vanderloop, City & County of Denver, 720-865-5459

References

U.S. Agency for Toxic Substances and Disease Registry, Division of Health Assessment and Consultation. *Public Health Assessment: Asarco Incorporated (Globe Plant), Denver, Denver County, Colorado.* 3 May 1995. Available at http://www.atsdr.cdc.gov/HAC/PHA/asarco/asa_toc.html.

Follow-up:	**Person Responsible:**
Interview Dave Williams to learn about the work group studying area-wide arsenic contamination in the greater Denver area.	Jennifer Tice and/or Elizabeth McManus

Contact: Keith Ross, Senior Hydrogeologist, LSI Adapt		**Contact Dates:** 2/20/02 and 3/1/02 **Caller:** Jennifer Tice
Category: Nongovernmental Organization	**Phone:** 206-654-7045	**E-Mail:** (Not available)
Website: http://www.lsiadapt.com		
Affiliation/Expertise/Notes: Jeff Andrilenas of the Area-Wide Soil Contamination Task Force suggested that we contact Mr. Ross, who worked at the Arizona Department of Environmental Quality from 1989 to 1995. When Mr. Ross was in Arizona, the Arizona DEQ was in the process of developing a formal policy for dealing with contamination from legally applied pesticides at former farmlands.		
Most Relevant to: __ Nature & Extent __ Protective Measures _X_ Institutional Frameworks *Specific deliverables:* Institutional alternatives.		
Key Points: Developer-led cleanup of former cotton fields in 1990s On 2/20/02, Mr. Ross explained that in the early 1990s, a few developers (Continental Homes and Hancock Communities) were developing land that used to be cotton fields near Phoenix, AZ. Some of this land had contamination that exceeded state cleanup standards. The developers, in consultation with the Arizona DEQ, cleaned up the site themselves. The cleanup involved excavating contaminated soil from certain areas on the site, replacing the excavated soil with clean fill in some areas, and moving the "dirty dirt" to areas on the site that would be covered by roads. Arizona DEQ now has stricter requirements On 3/1/02, Mr. Ross explained that Arizona DEQ had changed its policy since the time of that development. Developers cannot excavate and cover up contaminated soil on site at properties with historic pesticide contamination, as the developers in Phoenix did in the early 1990s. Instead, developers now have to remove all soil with contaminants above cleanup levels, do confirmational sampling, and submit the results to DEQ in order to receive a no further action (NFA) letter from DEQ.		
References / Referrals: • Wong Velasco, Voluntary Remediation Program, Arizona Department of Environmental Quality, 602-207-7656 (Mr. Ross got his information on Arizona DEQ's current policies from Mr. Velasco.)		
Follow-up: Interviewed Wong Velasco of the Arizona DEQ, who confirmed what Mr. Ross said about current State requirements.		**Person Responsible:**

Contact: Elizabeth Stasiak, Project Manager, Brownfields Best Practices, International City/County Management Association		**Interview Date:** 2/19/2002 **Interviewer:** Jennifer Tice
Category: Nongovernmental organization	**Phone:** 202-962-3509	**E-Mail:** estasiak@icma.org
Website: http://www.icma.org/go.cfm		
Affiliation/Expertise/Notes: ICMA has extensively researched brownfields programs in the U.S. and around the world and works directly with local governments in the U.S.		
Most Relevant to: __ Nature & Extent __ Protective Measures _X_ Institutional Frameworks *Specific deliverables:* Follow up research may lead to an institutional frameworks case study.		
Key Points: [Ms. Stasiak didn't feel she could help us until we more precisely defined the information on brownfields case studies we were looking for. She offered to answer questions or refer us to specific cases after we review ICMA's resources.]		
References / Referrals: • ICMA website's "Issues Intersection" on brownfields • ICMA, *Brownfields Blueprints: A Study of the Showcase Communities Initiative,* 2001. [Obtained]		
Follow-up: Ordered and reviewed *Brownfields Blueprints* book; selected Lowell, MA brownfields redevelopment as one of the institutional frameworks case studies. No additional follow-up required for the information survey.		**Person Responsible:**

Contact: Michael Storck, Project Manager, Utah Department of Environmental Quality		**Interview Date:** 2/20/2002 **Interviewer:** Jennifer Tice
Category: Government	**Phone:** 801-526-4179	**E-Mail:** mstorck@deq.state.ut.us
Website: http://www.epa.gov/region08/superfund/sites/ut/murray_.html		
Affiliation/Expertise/Notes: Murray Smelter, Superfund Site, Murray, Utah. Lead smelter operated between 1872 and 1949. COCs are lead and arsenic. Site remediation and residential property remediation. Superfund site. Reference by Greg Glass with note about innovative institutional controls.		
Relevant to: _X_ Nature & Extent _X_ Protective Measures _X_ Institutional Frameworks *Specific deliverables:* Tools for identifying area-wide contamination (XRF machine), range of protective measure alternatives, and operational analysis of institutional alternatives (what didn't work in this case). Potential institutional frameworks case study.		
Key Points: • The Utah Department of Environmental Quality did not support (or sign) the record of decision and the consent decree for the Murray, UT smelter site that were developed in a mediated process with the EPA, Asarco (the potentially responsible party), UDEQ, developers, and Murray City. • Along with process concerns, UDEQ has concerns about ground water protection (Ground water contamination is a more significant problem than soil contamination at this site.), the pace of the remediation, the enforcement of institutional controls, the extent of sampling that was done, and the amount of source material that will be left in place at this site. • The materials on the site were classified into four categories (based on chemical composition and source material) and different remedies were selected for each category of material. Remedies included *ex situ* and *in situ* capping of materials. • Mr. Storck recommends using an XRF (x-ray fluorescence) machine as a screening tool over large areas to identify "hot spots" with high concentrations of metals and then verify those results with wet chemistry analysis.		
References / Referrals: • Bonnie Lavelle, EPA Region 8, Remedial Project Manager, 303-312-6579 • Andy Kolomerus, MF & G, 303-447-1823 (Remediation contractor, would have all the technical documents) Documents Received: • Institutional controls developed for the Murray Smelter Site (sent by fax)		
Follow-up: Request technical documents from remediation contractor as needed.		**Person Responsible:** Kris Hendrickson

Contact: Wong Valesco, Arizona Department of Environmental Quality, Voluntary Remediation Program		**Interview Date:** 4/12/02 **Interviewer:** Jennifer Tice
Category: Government	**Phone:** 602-207-7656	**E-Mail:**
Website: http://www.adeq.state.az.us/environ/waste/capdev/voluntary/index.html		
Affiliation/Expertise/Notes: Mr. Valesco works in the Arizona Department of Environmental Quality's Voluntary Remediation Program. Keith Ross of LSI Adapt who worked at the Arizona Department of Environmental Quality from 1989 to 1995 referred us to Mr. Valesco as someone who could tell us about Arizona DEQ's policies for dealing with contamination from legally applied pesticides.		
Most Relevant to: __ Nature & Extent __ Protective Measures _X_ Institutional Frameworks *Specific deliverables:* identification of institutional alternatives		

Key Points:

The Arizona Department of Environmental Quality (DEQ) treats sites with historic pesticide contamination the same as any other contaminated properties.

This process, through the State of Arizona's voluntary cleanup program, consists of the following procedures:

- If contamination at a site exceeds state cleanup levels, the property owner defines the vertical and lateral extent of the contamination on a site and can choose whether to clean to residential or non-residential cleanup levels.
- If the property owner chooses to clean to residential levels, the DEQ will issue a no-further-action letter for the site.
- If instead the property owner chooses to clean to non-residential levels, the Arizona DEQ will attach a Declaration of Environmental Use Restriction (DOEUR or Declaration) to the no-further-action letter. This Declaration states that the property has been cleaned to non-residential levels and limits the uses of the property to non-residential uses. The Declaration will remain with the property deed for life. (If only a portion of the site has been cleaned to non-residential levels and the remainder meets residential cleanup levels, then the Declaration will include the boundaries of the non-residential areas on the site, which the property owner must declare to the DEQ.)

The DEQ encourages property owners to clean sites to residential cleanup levels.

References / Referrals:

None.

Follow-up:	**Person Responsible:**
None required.	

Contact: Dr. Peter Veneman, Professor and Department Head, Department of Plant and Soil Sciences, University of Massachusetts		**Interview Date:** 2/12/2002 **Interviewer:** Jennifer Tice
Category: Research	**Phone:** 413-545-5225	**E-Mail:** veneman@pssci.umass.edu
Website: http://www.umass.edu/plsoils/resume/veneman.html		
Affiliation/Expertise/Notes: Dr. Veneman is head of the soil sciences department at UMass Amherst and has researched the distribution of lead and arsenic in Massachusetts' orchard soils. Referred by Frank Peryea.		
Most Relevant to: _X_ Nature & Extent __ Protective Measures __ Institutional Frameworks *Specific deliverables:* sampling guidance and Yakima County sampling plan		

Key Points:

Research Findings

- Lead stays bound to organic matter in soils; very little lead was found deep in the soils of old orchards.
- Arsenic behaves like phosphorus and will leach. The finer the soil, the higher the arsenic is in the depth profile.
- Background levels of lead vary considerably depending on the parent materials of the soil.
- In unpublished research, Mr. Veneman studied the leaves and fruit of old apple orchards, and found that lead migrates to the cortex of the apple, while arsenic migrates to the leaves. Neither arsenic nor lead was found in significant concentrations in the fleshy part and peel of the apples and in juice or applesauce made from the apples.

Recommendations

- He recommends grid sampling of former orchards, because the concentrations of contaminants vary widely according to drip lines. It is "extremely hard" and expensive to sample these sites and come up with statistically valid results.
- He recommends mixing the soil and pushing topsoil around on properties out to get concentrations of lead under the legal limits (arsenic is more difficult to deal with).

References / Referrals:

Documents Requested:

- J. Bartos, and P.L.M. Veneman. 2001. "Heavy metal distribution in Massachusetts soils." J. Environmental Quality 30: (submitted).

Follow-up:	**Person Responsible:**
Follow up with document request if needed.	Jennifer Tice

Contact: Robert Wershaw, U.S. Geological Survey, Arsenic Studies Group		**Contact Date:** 2/8/2002 **Caller:** Jennifer Tice
Category: Research	**Phone:** 303-236-3980	**E-Mail:** rwershaw@usgs.gov
Website: http://wwwbrr.cr.usgs.gov/Arsenic/		
Affiliation/Expertise/Notes: Dr. Wershaw is the contact person for the USGS Arsenic Studies Group.		
Most Relevant to: __ Nature & Extent __ Protective Measures __ Institutional Frameworks *Specific deliverables:* None.		
Key Points: Mr. Wershaw explained that the USGS Arsenic Studies Group does not sample sites and that our project is not the kind of thing USGS normally does. He suggested that we look at what the EPA is doing in the Denver area near the Globeville smelter. Sampling there showed arsenic contamination in people's lawns, probably from fertilizer application. [Note: We have interviewed Barbara O'Grady of the Colorado Department of Public Health and Environment about the Globeville site and will interview Dave Williams of EPA about the area-wide contamination in the Denver area.]		
References / Referrals: • Martin Goldhaber, USGS, 303-236-1521 (Mr. Goldhaber is also in the USGS Arsenic Studies Group and might be able help us.)		
Follow-up: Interviewed Martin Goldhaber. No additional follow up needed at this time.		**Person Responsible:**

Contact: Cheryl Yates, Kootenay Boundary Community Health Services, Trail, BC		**Interview Date:** 2/21/2002 **Interviewers:** Jennifer Tice and Elizabeth McManus
Category: Government	**Phone:** 250-368-5323	**E-Mail:** clyates@kbchss.hnet.bc.ca
Website: Trail Community Lead Task Force, http://mypage.direct.ca/t/tlp/index.html		
Affiliation/Expertise/Notes: The Trail, BC lead-zinc smelter has operated since the beginning of the 20th century. The Trail Community Lead Task Force was formed in 1990 with a goal of reducing children's blood lead levels; it completed its work in 2001. Cheryl Yates has been with the project since 1989 and manages the health, education, and case management services related to lead exposure for the Trail community.		
Most Relevant to: __ Nature & Extent _X_ Protective Measures _X_ Institutional Frameworks *Specific deliverables:* Institutional and protective measure alternatives and analysis. Potential institutional frameworks case study.		

Key Points:

- The Trail Community Lead Task Force and the Trail Lead Program Office were able to reduce children's blood lead levels without a lot of soil removal, which the community did not want. Instead, Cominco reduced the emissions of its lead-zinc smelter; the Trail Program embarked on an extensive educational and health monitoring effort; and, the City of Trail uses primarily "barrier methods" (such as planting and maintaining ground cover) to reduce exposure.
- Soil lead levels have remained around 700 to 750 parts per million, but blood lead levels have declined over the last decade (with variations based on weather conditions)—especially since 1997, when Cominco began operating a new, cleaner smelter.
- The program did an exposure pathways study for lead, and has a model that is predictive for children's blood lead levels. Air emissions seem to be a more significant source of exposure than direct soil ingestion.
- Ms. Yates recommended involving members of the community on a committee, like the Trail task force, as a means of deciding what to do to address area-wide contamination problems.

References / Referrals:

- Steven Hilts, Cominco, 250-364-4385 (he was the environmental manager for the project)

Documents Received:

- PowerPoint presentation on community collaboration in the Trail Lead Program
- PowerPoint presentation on the Fall 2001 blood lead levels in Trail
- Various educational materials for the Trail Lead Program

Follow-up:	**Person Responsible:**
Requested and received supporting documents. Interviewed Steve Hilts. No additional follow up required.	

Appendix C:

Annotated Bibliography for Task 3 – Nature and Extent

Appendix D:

Annotated Bibliography for Task 4 – Protective Measures

Appendix E:

Annotated Bibliography for Task 5 – Institutional Frameworks